with the methods and apparatus of the claimed invention, because the present methods and apparatus provide for the delivery of ozone independent of the processing fluid (application, p 14).

In the methods and apparatus disclosed in the prior art, on the other hand, ozone is generally <u>dissolved</u> into an aqueous solution, in a liquid tank or bath, in order to make it available for the oxidation process on the surface of the semiconductor workpiece. As a result, the amount of ozone deliverable to the surface of the semiconductor workpiece is limited to the amount of ozone that can actually be dissolved into the processing fluid. Accordingly, in the past, there was no motivation to contemplate using high capacity ozone generators, because any excess ozone produced would not be absorbed by the processing fluid. Rather, with the prior art processes, any excess ozone would eventually dissipate and be wasted (application, p. 14). Consequently, the motivation in the prior art, if any, was to avoid creating ozone at greater than 90 grams/hours. Initially, creating such amounts of ozone in connection with prior art processes was unnecessary and undesirable, from a facilities and cost point of view. Moreover, ozone is a toxic and highly reactive or corrosive gas. It therefore requires special materials and procedures for containing it, handling it and disposing of it. As a result, in the prior art, since only lower amounts of ozone could be used, only lower amounts (less than 90 grams/hour as claimed) were created and used. Thus, it would not have been obvious for one skilled in the art to use such high concentrations of ozone to process or clean a workpiece.

Turning to the cited references, Matthews does not teach or suggest the use of high concentrations of ozone to process a workpiece. On the contrary, Matthews teaches cleaning a semiconductor wafer by placing the wafer into a liquid bath containing subambient deionized water for removing organic materials from the wafer (col. 5, lines 17-24; col. 6, lines 35-37). Matthews limits its discussion to a process that includes slowly diffusing ozone <u>into a tank</u> of deionized water,

or placing the wafers into a tank containing chilled ozonated water at a temperature of about 1° C to 15° C (col. 5, lines 42-45; col. 3, lines 62-63). Thus, Matthews also teaches away from using a heated liquid, or a liquid heater, as recited in claims 1, 2, and 15.

Additionally, Matthews does not teach forming a liquid boundary layer on the surface of a wafer, and does not teach diffusing ozone through a <u>liquid boundary layer</u>, but instead teaches diffusing ozone into a <u>bath</u>. In addition, by employing low water temperatures, which slows reaction rates, Matthews teaches away from the claimed heated liquid steps.

None of the other references teach diffusion of ozone at all. Thus, the cited references are substantially unrelated to the claimed invention. Moreover, none of the cited references disclose the use of a high capacity ozone generator, nor do they suggest introducing ozone into a workpiece environment at a rate of at least 90 grams per hour.

To illustrate, Yoneda teaches spraying ozone into a chamber to form a thin oxide film on the surface of a wafer to protect the wafer (col. 6, lines 42-45). The thin oxide film is not a liquid boundary layer through which ozone may be diffused, but is instead an oxide layer formed by ozone. Yoneda makes no mention of using a high capacity ozone generator.

Kosofsky et al. discloses a pressure-washing system for washing large objects, such as automobile engines and air-conditioners, and for recovering oil, chemicals, and other hazardous materials from the large objects (col. 1, lines 31-42, 52-55; col. 2, lines 14-16). Kosofsky et al. does not teach forming and controlling the thickness of a liquid boundary layer on a workpiece, and it makes no mention of using a high capacity ozone generator. Thus, the pressure-washing system of Kosofsky et al. is entirely unrelated to the claims.

Mashimo et al. and Bergman teach general wafer-cleaning methods and apparatus. Neither reference teaches introducing ozone into a workpiece-containing environment at a rate of at least 90 grams per hour, or using a high capacity ozone generator. Specifically, Mashimo et al. is directed to a deionized water/gas mixer, and teaches dissolution of a cleaning gas into deionized water (col. 3, lines 27-39). Thus, Mashimo et al. is not applicable to diffusion of ozone gas through a boundary layer. Bergman teaches uniform etching with HF and/or HCl (Abstract), and makes no mention of using high capacity ozone. Thus, Bergman too is substantially unrelated to the claims.

In view of the foregoing, it is submitted that the claims are in condition for allowance, and a Notice of Allowance is requested.

Respectfully submitted,

LYON & LYON LLP

Dated: June 11, 2002

By: Kenneth H. Ohrner

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#10

In re Application of: Eric J. Bergman

Application No. 09/621,028

Filed: July 21, 2000

For: Process And Apparatus For Treating A Workpiece Such As A SemiConductor Wafer

OIPE JUN 17 2002 PATENT & TRADEMARK OFFICE

The owner, Semitool, Inc. of 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application, which would extend beyond the expiration date of the full statutory term defined in 35 U.S.C. 154 to 156 and 173, as presently shortened by any terminal disclaimer, of prior U.S. Patent No. 6,267,125; 6,240,933; 6,273,108; and Application Nos. 09/811,925; 09/536,251; 09/837,722; 09/836,080; 09/061,318. The owner ~~hereby agrees~~ agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term as defined in 35 U.S.C. 154 to 156 and 173 of the prior patent, as presently shortened by any terminal disclaimer, in the event that it later: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321, has all claims cancelled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

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Kenneth H. Ohriner 6/10/02

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Version of Claims with Markings to Show Changes Made

1. (Amended) A method for processing a workpiece, comprising the steps of:

providing a heated liquid onto [the] a surface of the workpiece that is to be treated, the heated liquid assisting in maintaining the workpiece at an elevated temperature;

introducing ozone into an environment containing the workpiece at a rate of at least 90 grams per hour;

controlling [the] a thickness of the heated liquid on the workpiece so as to form a liquid layer that allows for diffusion of the ozone through the layer for reaction at the surface of the workpiece , to process the workpiece.

2. (Amended) A method for cleaning [the] a surface of a workpiece, comprising the steps of:

providing a heated liquid solution of water and at least one of HF and HCl onto the surface of the workpiece, with the heated solution assisting in maintaining the workpiece at an elevated temperature;

introducing ozone into an environment containing the workpiece at a rate of at least 90 grams per hour;

controlling [the] a thickness of the heated liquid solution to form a thin liquid boundary layer on the surface of the workpiece to allow diffusion of the ozone through the boundary layer for reaction at the surface of the workpiece , to clean the workpiece.

15. (Amended) A system for processing a workpiece, comprising:

a liquid reservoir having a liquid chamber;

one or more nozzles in a process chamber for spraying fluid onto the workpiece;

a fluid path connecting the liquid chamber to the nozzles;

an ozone supply system for injecting ozone into the fluid path or into the chamber, and having a capacity of at least 90 [gpm] <u>grams per hour</u>; and

a heater for heating the liquid before the liquid is provided onto the workpiece.

23. (Amended) The system of claim 15 further comprising means for controlling [the] <u>a</u> thickness of [the] <u>a</u> liquid layer on the workpiece, including at [a] least one of:

a rotor for rotating the workpiece;

a fluid flow controller[;] or one or more nozzles adapted to generate fine droplets of the [treatment] liquid.